ミストによる温冷感のうち視覚的要因が与える影響 EFFECT OF VISIBLE PERCEPTION OF MIST ON THERMAL COMFORT VOTES

〇アカデミック会員 ファーナム クレイグ*1

Craig FARNHAM^{*1}

^{*1}大阪市立大学生活科学研究科 Dept. of Human Life Science, Osaka City University, Sumiyoshi-ku, Osaka, 558-8585 Japan

Background



most).In Japan, wet bulb depression is about 7K in summer, 10K on the hottest days

Droplet diameter (µm)

Thermal sensation improved 3 steps on average among 141 surveyed people

Spray volume 19ℓ/h Blown air 80m³/min

If there is a mist with no cooling, do people still think it feels cool?

To create a mist that is not cool and evaluate it,

- 1. Use a weakly coooling type of mist, but visible. Ultrasonic mist generator makes very small droplets (under 10µm) with low water mass flow. Cooling effect is small.
- 2. Add a heater to slightly warm the air (secretly) Heat the air to cancel the small cooling effect of the ultrasonic mist, create zero temperature change, or even a temperature increase. Do not let test subjects know there is heating.
- 3. Compare to non-mist cooling Compare 2 misting fans, one spraying mist, and one not spraying. Ask people to compare the feeling of coolness.

Experiment Setup and Conditions Ultrasonic misting fans + copper coil with hot water

flow as heat





Round 1 162 people August 6-7, 2016 Open Campus event at university Outdoors, Sunny, High temperature 35~36°C, Humidity 42-45%



99 people Round 2 October – November, 2016 Indoors at university Temperature 20-27°C

Experiment Procedure

- 1. Blow air from 2 fans at same speed. One spraying, one not.
- 2. Start flow of water into heat exchanger behind spraying fan (hidden) and vary water temperature, causing change in blown air temperature.





Questionnaire form

Note: Test subjects did not know the true nature of the experiment. It was presented as only a comparison of mist and no mist. Actually, it is a test of temperature and perception of mist.

Questionnaire on mist fan coolness

Date, time:		M / F		Age	
Which fan feels cooler?	Comments		Where were you		



4. Answer short questionnaire.



Results of questionnaire





In all experiments, 71% of subjects chose the mist as coolest, even though the mist was often the same temperature or higher than the non-misting fan.

What is the relationship to actual temperature?

Measured temperature difference

- The temperature records were correlated with the logged time of each survey form.
- The difference ΔT between the temperature sensors at 50cm distance was taken.
- Positive values indicating the misting fan air flow was actually warmer than the non-misting fan air flow.
- The heat exchanger rig was not easily controlled, but the range of temperatures during the surveys was a difference of -0.5K up to 1.7K.



$$\Delta T = T_{mist} - T_{no-mist}$$



Misting fan is cooler



Misting fan is actually warmer

Perception of coolness vs. temperature difference

Conclusions

Visible mist appears to yield a slight increase in the



"Which fan is cooler?" All responses from outdoor and indoor trials (n = 261)



- perception of coolness regardless of temperature.
- A misting fan was judged as cooler than a fan without mist even when the misted air flow was up to 0.6K warmer.
- Mist cooling installations may be able to increase the perceived comfort by ensuring the mist itself is visible, rather than blocked from view in a duct or by a wind screen.
- More thorough experiments over a wider range of conditions will better define this likely effect for use in thermal comfort models.

Corresponding author:



Craig FARNHAM, E-mail: farnham@life.osaka-cu.ac.jp